

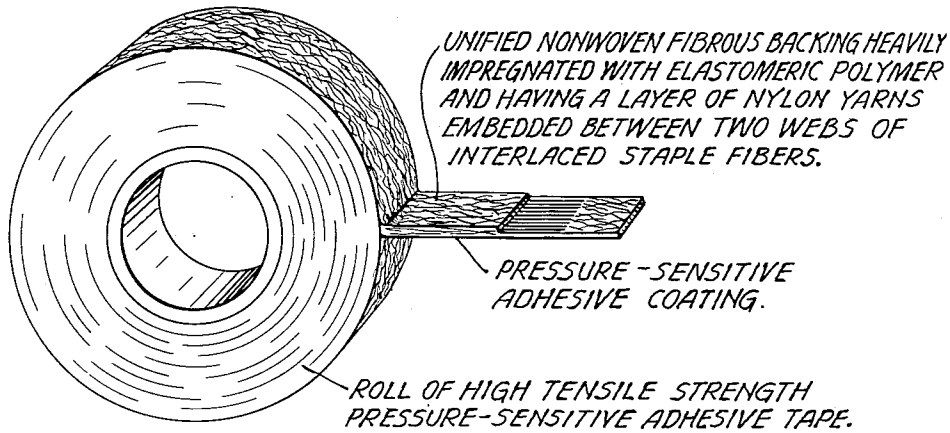
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R. J. LAMBERT

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NONWOVEN PRESSURE-SENSITIVE SHOE TAPES

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INVENTOR
RICHARD J. LAMBERT
BY
Carpenter, Abbott, Boulter & Kinney
ATTORNEYS

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3,015,597 NONWOVEN PRESSURE-SENSITIVE SHOE TAPES

Richard J. Lambert, East Oakdale Township, Washington County, Minn., assignor to Minnesota Mining and Manufacturing Company, St. Paul, Minn., a corporation of Delaware

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1 Claim. (Cl. 154—53.5)

This invention relates to nonwoven pressure-sensitive shoe tapes (and the like) of high tensile strength.

Pressure-sensitive shoe tapes employed in the manufacture of shoes as top line reinforcing tapes and as strap reinforcing tapes have customarily comprised a woven cloth backing coated with a normally tacky, pressure-sensitive adhesive. Woven cloth backings have been employed in order to obtain the necessary combination of high tensile strength, bi-directional strength, stretch and elastic recovery, and stitchability, together with suitable thinness and flexibility. However, cloth-backed tapes have the inherent disadvantage of ravelling. Paper cannot be substituted for cloth for this usage.

An object of the present invention is to provide nonwoven, nonravelling, pressure-sensitive adhesive tapes useful as shoe tapes on account of possessing the necessary combination of physical characteristics.

I have discovered that a commercially useful nonwoven tape having the requisite properties can be manufactured by employing a backing formed of two unified interbonded tissue-like webs of interlaced staple textile fibers (at least one of which includes a substantial proportion of nylon staple fibers) and, embedded therebetween, a nonwoven layer of lineally-aligned yarns of continuous nylon filaments; the fibrous structure being impregnated and unified by a fiber-binding elastomeric latex sizing agent deposited from aqueous solution, the total dry solids weight thereof being greater than that of the fibers and yarns.

One side of the unitary backing is coated with a suitable pressure-sensitive adhesive. The other side is preferably given a backsizing coating to provide a back surface that permits of ready unwinding of rolls of the tacky tape. The unified fibrous backing does not split or delaminate, and there is no ravelling, even when an aggressively tacky adhesive is used; hence the tape can be unwound from a roll without disruption.

The accompanying drawing schematically illustrates this tape product, the tip of the backing being cut away to expose the layer of yarns.

This construction provides the tape with bi-directional strength. The crosswise strength is provided by the unified elastomer-impregnated tissue-like webs of interlaced staple textile fibers. The fibers are preferably at least approximately one inch in length and cross over and under each other, extending randomly in various directions. A unified compacted layer of such fibers thus provides strength and toughness in both the crosswise and lengthwise directions of the tape. Rayon fibers are desirable and at least one of the webs should include a substantial proportion of nylon fibers to impart greater toughness.

The lengthwise strength of the composite tape is mainly provided by the lineally-aligned yarns of nylon filaments, which are parallel to each other and to the edges of the tape, and are embedded between the tissue-like webs. These yarns (or groups of yarns) can be spaced from each other by distances greater than the width of a yarn. The use of nylon yarns permits of readily obtaining a lengthwise tensile strength of at least 100 pounds per inch of width, combined with desired elastic stretch

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and retraction properties. This composite backing permits of an elongation of several percent under moderate stresses, which is an important feature for desired shoe tape usages. The elastic properties of nylon yarns are restrained in part because the yarns are embedded within the described unified fibrous structure; thus preventing the tape from being too stretchy and elastic. Yet the composite structure permits of a desired degree of elongation and of sufficient elastic recovery or retraction to maintain a snug or taut configuration or fit when the tape is utilized.

This construction permits of variations to obtain the most desirable combination of crosswise and lengthwise properties for any given use, which can best be determined by making up samples and testing them. Although the use of rayon and nylon has been specified above, since at present these seem to be most suitable for making desired tapes of lowest cost, equivalents may be employed when available.

Example

Each of the nonwoven unified fibrous tissue-like webs employed in making the composite backing can be produced by processing nonbundled staple textile fibers in a machine which randomly interlaces the fibers to form a layer wherein the fibers cross over and under each other so as to be held together by mechanical and frictional forces. The fibers are unoriented, extending randomly in various directions, and thus impart both crosswise and lengthwise tensile strength and tear resistance.

The web can be formed by use of a garnett machine or by use of a "Rando-Webber" machine (sold by Curlator Corp., Rochester, N.Y.). The staple fibers should have a length of at least one-half inch and preferably at least approximately one inch. The fibrous web is unified by impregnation with an aqueous latex emulsion of an elastomeric fiber-binding sizing agent, such as a rubbery polymer of methyl acrylate, ethyl acrylate, or a copolymer of methyl and ethyl acrylates. The web is also compacted, if in a fluffy condition, so as to result in a tissue-like web. Both steps can be conveniently performed by passing the fibrous web through the nip of a pair of squeeze rolls, the lower one of which dips into a bath of fiber-binding solution. The upper roll is covered with a rubber or other resilient sleeve and the lower one has a knurled steel surface. The roll pressure is adjusted so that excess sizing solution is squeezed out and the fibrous web is compacted, resulting in a damp tissue-like fibrous web; which is thereafter dried by passing around heated rolls.

A preferred backing utilizes two specifically different fibrous webs in laminated unified combination. One web is comprised of stable viscose rayon fibers of medium or regular tenacity, 1½ denier, 1¼ inch length. The other web is comprised of equal parts by weight of these rayon fibers and of nylon fibers of 3 denier, 1½ inch length. Both webs are unified by impregnation from aqueous latex solution with approximately 25% (percent by weight on dry solids basis of the impregnated web) of acrylic elastomer (polymer of methyl or ethyl acrylate or copolymer). The dried webs each have a thickness of 5 to 6 mils and are porous. The all-rayon web in final unified form has a weight of 37 pounds per 1000 square yards, and the rayon-nylon web has a weight of 56 pounds per 1000 square yards. The presence of nylon fibers in at least one of the webs is desirable in order to impart greater bi-directional toughness. The proportion can be increased, and either or both of the webs may consist mainly or entirely of nylon fibers, but this increases the cost and has been found unnecessary in the manufacture of satisfactory shoe tapes.

The backing components can be conveniently combined

and unified by feeding the two fibrous webs into the nip of a pair of squeeze rolls together with an interposed sheet of nylon yarns drawn from a warp beam. The lower roll dips into a bath of aqueous latex solution of the elastomeric fiber-binding sizing agent (which can be the same acrylic polymer mentioned above), thereby causing the sizing to impregnate the porous mass of the composite material and to bond together the two fibrous webs and the interposed yarns. A sizing weight of about 140 pounds per thousand square yards (dry solids basis) is suitable. The squeeze rolls also serve to compact the composite web. A unified unitary backing is thus formed. The damp sheeting is dried by passing over heated cylinders.

A backing having a lengthwise tensile strength of 150 pounds per inch width can be made by employing nylon yarns of 210 denier, there being 34 continuous filaments per yarn, with 2 yarns per dent, and 18 dents per inch width (thus providing 36 paired yarns per inch width).

The resultant somewhat porous sheeting is given two successive squeeze roll coatings of the acrylic latex solution on the rayon-nylon side, followed by drying in each case, in order to render it less porous and to provide a smoother back surface which is of a kind that permits of ready unwinding of the finished rolls of adhesive tape. These coatings provide an additional 50 pounds per thousand square yards of acrylic elastomer. In the finished backing the total weight of acrylic polymer substantially exceeds the total fiber and yarn weight. This tough and elastic polymer contributes materially to the toughness of the backing.

The finished backing is coated on the all-rayon side with a suitable pressure-sensitive adhesive. These are well known in the art and need not be described in detail. Preferably, the adhesive is applied from an aqueous dispersion thereof. Following adhesive coating and drying, the web is slit into tapes of desired width which are wound up into rolls of desired length.

A typical adhesive tape product made in this way has a caliper thickness of 14 to 15 mils, a lengthwise tensile strength of 150 pounds per inch width, an elongation of about 4% under a tensile pull of 20 pounds per inch width, and an ultimate elongation of about 25% before breaking. Upon release of moderate pulling stresses the tape elastically retracts to maintain a snug or taut configuration. The tape receives and holds stitches and has adequate crosswise strength and toughness, and yet is suffi-

ciently thin and flexible for use as a shoe tape. There is freedom from ravelling of the yarns owing to their embedded relationship in the unified elastomer-impregnated fibrous backing structure.

5 I claim:

A nonwoven pressure-sensitive adhesive tape of the character described, having a nonwoven fibrous backing coated on one side with normally tacky pressure-sensitive adhesive, the backing being formed of two interbonded 10 tissue-like webs of interlaced staple textile fibers having a length of at least approximately one inch, at least one of which includes a substantial proportion of nylon staple fibers, and a nonwoven layer of lineally-aligned yarns of continuous nylon filaments embedded between said 15 webs, the fibrous backing structure being impregnated and unified by elastomeric fiber-binding latex sizing agent so that the tape product can be unwound from a roll without disruption, the elastomeric sizing agent having a dry solids weight greater than that of the fibers and yarns, 20 the nylon yarns being in adequate number so that the tape has a lengthwise tensile strength of at least about 100 pounds per inch width.

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